**Magnetic effects on Bjurbole (L4) chondrules moving from space to terrestrial environments.** G. Kletetschka[1], P. T. Wasilewski[2] and M. Berdichevsky[3], [1]CUA-GSFC/NASA, Code 921, Greenbelt, 20723, MD, USA, gunther.kletetschka@gsfc.nasa.gov, [2]GSFC/NASA, Code 691, Greenbelt, 20723, MD, USA, u1pjw@lepvax.gsfc.nasa.gov, [3]Eleanor High School, Greenbelt, 20723, MD, USA, chillywilly013@yahoo.com.

**Introduction:** Ordinary chondrites, are undifferentiated conglomerates of primitive material, containing intermixed grains of olivine, pyroxene, feldspar and metallic Fe-Ni compounds. These are the materials most likely matched with the S-type asteroids. Ordinary chondrite (H, L, and LL types) magnetism is due to Fe-Ni compounds, primarily $\alpha$-kamacite (<7% Ni), $\gamma$-taenite (>7% Ni), and $\gamma''$-tetrataenite (43-52% Ni). We need to understand how laboratory meteorite magnetism research relates to the magnetic record of the asteroids. During the meteorite entry into the Earth atmosphere the meteorite interior will warm from temperatures on the order of 70-150K to about 300K in the presence of geomagnetic field. We investigate if this warming event can have any impact on the observed magnetic record of meteorites.

**Acquisition of magnetism during the residence inside the geomagnetic field:** Previous magnetic study of Bjurbole (L4) chondrules [1] described very stable remanence directions even after AF demagnetization with 0.24 T Meteorites dominated by Kamacite have very unstable remanent magnetization characterized by rapid intensity decrease upon low (5mT) alternating magnetic field (AF) demagnetization.and chaotic remanence directions The stable magnetization is most likely ascribed to the presence of Tetrataenite and the unstable magnetization with Kamacite. Our objective is to examine the magnitude of terrestrial contamination associated with the entry of meteorites from space into the terrestrial environment. Most of our experimental magnetic work was done on individual chondrules from Bjurbole (L4) ordinary chondrite. Bjurbole fell 12 March 1899 at 22:30 hours near Borga, Nyland, Finland. One stone fell through the sea-ice and broke into fragments. The total weight was around 330 kilograms and the largest fragment was 80 kilograms. It is classified as an L4 and is very friable. The friability of Bjurbole allowed easy separation of individual chondrules from a bulk piece of the meteorite. Even though separated chondrules are small (1-50 mg) they still posses significant magnetization measurable with our superconducting rock magnetometer (SRM) which is part of Goddard magnetic facility. Remanent magnetization was removed stepwise by alternating field demagnetization in 0.020, 0.035, 0.070, 0.150, 0.300, 0.600, 0.120, and 0.240T. The resulting moment was the initial state of our low temperature experiments and is marked in Figure 1 as "AF dmg". Chondrules were then cooled down to liquid nitrogen temperature (77K) in zero external field (background noise up to 1 nT). This state is denoted as "ZFC" in Figure 1. Chondrules were than exposed to 40,000 nT laboratory field (LF) while at 77K temperature (LFC in Figure 1) and warmed up to a room temperature at 300K (LFW in Figure 1). This process should mimic the entrance of the meteorite into the Earth magnetic and thermal environment.

**Results** Chondrules B1 and B2 in Figure 1 are influenced by the cryogenic and geomagnetic field environment. The low temperature cooling in zero field (ZFC) had significant effect on this group and the magnetization was noted to either rapidly increase or decrease after AF demagnetization (AF dmg). When exposing these chondrules to the geomagnetic field at 77 K a significant component was gained parallel to the lab field (LF). For example the B1 chondrule had upward magnetization ~parallel to the LF. Upon cooling in zero field this component disappeared and a reversed downward component was noted. Exposing the chondrule to the LF at 77K completely reversed its magnetic moment from a downward direction to an upward direction that stabilized close to the ambient lab field (LF). During warming to room temperature the chondrule gained additional magnetic intensity parallel to the LF. Thus the magnetization of this chondrule is extremely sensitive to low values of ambient magnetic field and acquires significant magnetization as soon as exposed to the geomagnetic field. (40,000nT). Chondrule B2 is a bit more stable because it was able to hold its magnetic moment in direction opposite to geomagnetic field after AF demagnetization as well as when cooled to 70K and exposing to geomagnetic field at this temperature. However, warming to 300K causes this chondrule to gain major component parallel to geomagnetic field as well.

Chondrules B3 and B6 are relatively unaffected. Low temperature treatment has negligible effect on their magnetic remanence.

**Conclusions:** Magnetic record of the Bjurbole chondrite and by analogy perhaps all meteorites is complicated be the fact that it contains magnetic material capable of acquiring a wide range of magnetic remanence records by warming from space temperature and magnetic conditions to 300K inside the terrestrial environment. However, there is also a significant fraction of chondrule record that contains stable remanent directions that is unlikely to be contaminated by exposure to geomagnetic field and terrestrial temperatures.

Consequently the next step is to assess the bulk effect of the space to earth transit.

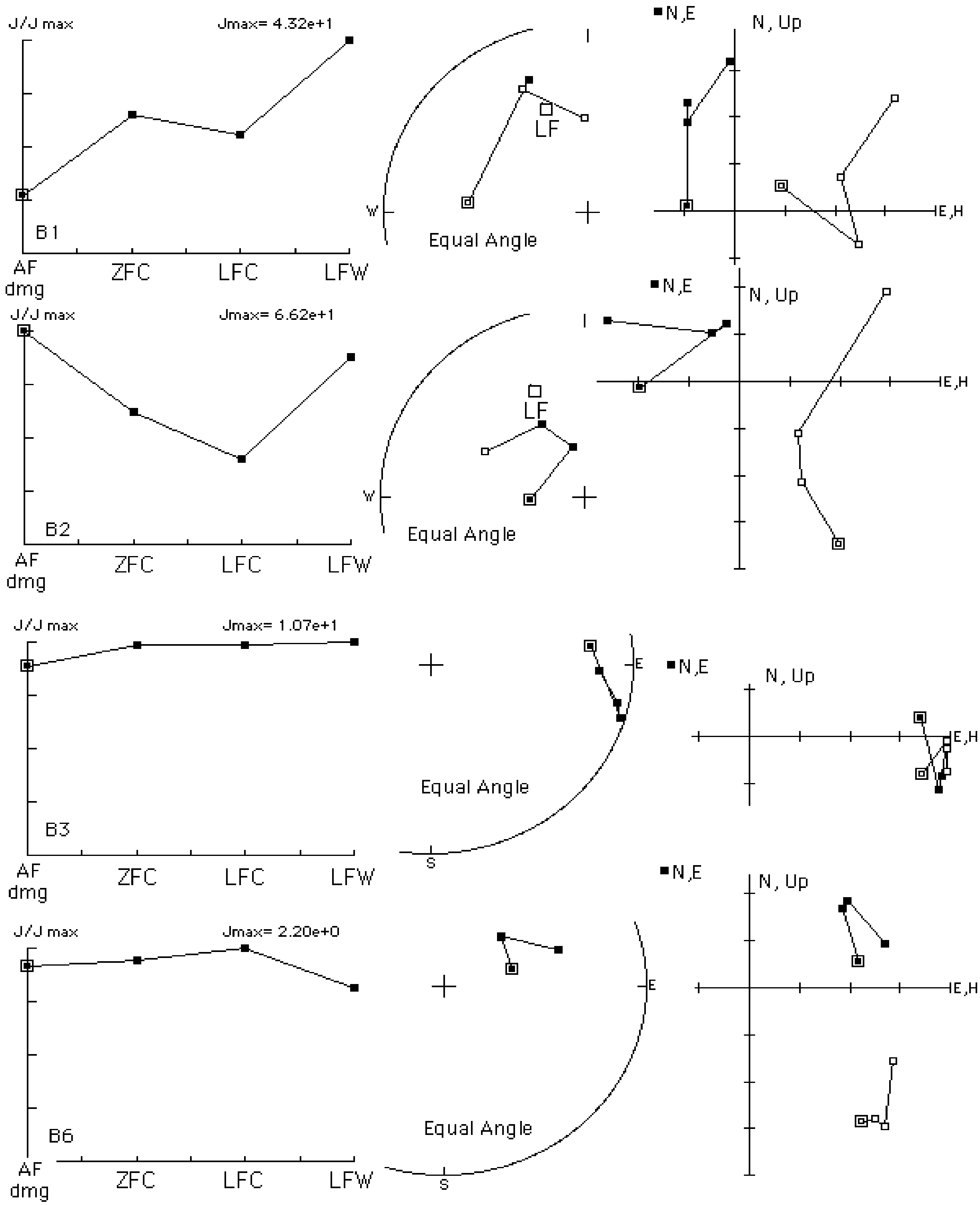


Figure 1: Left panel are magnetic intensity plots in various thermal and field conditions, middle and right panels are equal angle stereonet and Zijdervelt projections of the same data set, respectively. AF dmg – demagnetized NRM starting point, ZFC – zero field cooling to LNT, LFC – application of laboratory field, Jmax in $10^{-4}$(A $m^2kg^{-1}$)..

**Reference:** Wasilewski, P. et al. (2000) *Meteoritics and Planetary Science, 35,* 537-544.